In-parallel Ventilator Sharing During an Acute Shortage: Too Much Risk for a Wider Uptake

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To the Editor:

We read with interest the article by Beitler and colleagues on ventilator sharing among patients with Covid-19-associated acute respiratory distress syndrome (ARDS) [1].

The COVID-19 pandemic has forced clinicians to develop strategies to avoid denying care due to ventilator capacity shortages induced by patient demand surges. Nevertheless, the safety of these strategies has been difficult to guarantee, as summarised in a recent multi-society consensus statement [2].

Beitler et al. implemented a careful protocol of shared, in-parallel (i.e. simultaneous, breathing-together) ventilation circuit [1]. Their methodology demonstrated the feasibility of ventilator sharing, but at the cost of several major limitations we believe could prevent generalization or wider uptake, including:

1. Patient compatibility criteria are crucial and require time and expertise. Unfortunately, *COVID-19 "overrun", as we will call it, is a situation where time is "negative"*. For many clinical staff there is little time or ability to spend matching patients, and monitoring it when patient course diverges. Many hospitals worldwide do not have the nursing levels in the US.

2. The patient-specific monitoring required is necessary, but adds circuit complexity, cost and technology that may not be available in many centres worldwide. It will also require significantly more technical expertise than is available outside major centre hospitals.

3. Rescue ventilators (as a safety measure if shared ventilation fails) may not be available or may understandably also be in use in such a situation.

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4. Pressure control when patients breathe together does not ensure lung damage from divergent patient courses does not occur. Driving pressure and barotrauma are an issue if compliance rises significantly for one patient. Similarly for, under-ventilation and a need for greater pressure in one patient. This approach thus puts great weight on not only patient matching but matching and tracking patient course to avoid damage. It may work in a limited trial and study, but not necessarily in a COVID-19 "overrun" situation, where staffing capability is stretched to the limit.

5. The authors state: "*Patient selection and management require considerable expertise to ensure safety. Therefore, we recommend a regional referral model wherein ventilator sharing is restricted to expert centers, and patients and ventilators move throughout the region accordingly*." However, it requires significant time, cost and effort to move infectious patients. It also implies greater risk for a select set of patients in the receiving centre(s), which may not be ethical or provide equity of access to care for patients.

Importantly, we admire this result, but feel in-parallel ventilation carries too much risk and difficulty to implement safely.

We would thus draw the authors attention to the concept of in-series breathing (patients breathe one-after-the-other) in a simply implemented active circuit [3], as a safer alternative. It allows individualized PEEP and driving pressure to account for differences between patients, and reduces risk of harm because patients breathe separately (not together).

Thus Beitler et al. [1] developed excellent results in a limited test situation, but added significant complexity and cost per patient, which may not be feasible in general or in COVID-19 overrun. The use of in-parallel breathing requires significant matching of patient condition

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and monitoring of time course to assess risks of barotrauma/volutrauma (even with pressure control), as well as a risk of under-ventilation. All these risks are well-known to be difficult to monitor and assess in the best of times. A COVID overrun situation demanding ventilator doubling is not the best of times.

We suggest in-series breathing as a safer solution.

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